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Abstract. The popularization of technology in the higher education environment has raised awareness about the importance of educators' technological knowledge for teaching and learning. The Technological Pedagogy Content Knowledge (TPACK) framework explains the set of knowledge that educators need to be equipped with for enhanced pedagogies. This will help them to adapt to the expectations of their digital native students. From a training needs analysis conducted in a higher education institution in Malaysia, a two-day training was conducted for the institution's lecturers to cultivate their use of video technology based on the TPACK framework. The training facilitators evaluated the lecturers' performance, and the results of the evaluation were presented in this study. Results show that the training successfully closed the identified training gap, and enhanced the lecturers' capabilities in using video technology for teaching and learning purposes across various disciplines.

Keywords: TPACK, higher education, training, technology use, teaching and learning.

1 Introduction

The use of technology has become a vital skill for educators in 21st-century teaching and learning. Technology has also been recognized as a powerful solution to urgent educational challenges such as the global pandemic [1], which has further accelerated educational advancement [2, 3]. However, this was burdensome to educators who perceive technology as opaque and protean [4, 5].

While technology in education is devised to facilitate knowledge transactions in academic settings, educators and students might not process knowledge and information similarly [6, 7]. According to a previous study [8], digital transformation

has greatly impacted the educational environments in which students (also known as digital natives) learn differently from their educators (digital immigrants). It was explained that educators are indeed experts in their content areas, but are not well-trained on how to incorporate technology for teaching purposes [2].

This is consistent with past research [8] that many university lecturers are knowledgeable and skilled in their subject fields, yet professional development activities are needed to help them augment their experience with technology. It had been pointed out previously that educators were not provided with sufficient training and their experience with digital technologies for teaching purposes was dearth [9]. It is also not an unusual issue in developed higher education contexts like Sweden, where educators also demand professional training on using digital tools for pedagogical enhancement [10].

In the context of this study, a training need analysis was conducted in a higher education institution to identify training gaps and needs of the lecturers. The analysis found that the lecturers required training on technology use and teaching digital natives. The lecturers had also indicated their desire to learn how to create and present contents using videos to help them further develop and adapt e-learning materials. The lecturers also showed interests in exploring more features and techniques on Microsoft PowerPoint to enrich lesson presentations. To remedy this gap, a two-day training workshop was conducted to guide lecturers in identifying suitable strategies to teach digital natives using videos and advanced features of Microsoft PowerPoint for lesson delivery.

Following the workshop, the researchers were interested to evaluate to what extent the technology knowledge and skills that were taught could be used effectively by the lecturers for teaching purposes. Hence, facilitators of the workshop evaluated the lecturers' lessons which incorporated technology components taught during the workshop (videos and PowerPoint features) using the Technological Pedagogical Content Knowledge (TPACK) framework.

2 Literature Review

The TPACK framework was introduced by Koehler and Mishra [4] as a powerful framework that conceptualizes how educators use technology to support teaching and learning. It was proposed that there was a gap in the field of educational technology as technology was discussed independently from teaching and learning [11]. Hence, the TPACK framework extended Shulman's idea of Pedagogical Content Knowledge by emphasizing technology integration in educators' teaching. The TPACK framework addresses the gap by emphasizing technology components and how educators incorporate technological knowledge into their pedagogical and content knowledge [4, 11]. The framework has since exuded great influence not only in educational research and practice but also in professional development for educators [11]. It is also known as a practical guide to the development of research and program for its emphasis on the integration of technology into pedagogy and technology [12].

As illustrated in Fig. 1 below, the TPACK framework consists of three primary domains and four intersected domains of the primary forms [4]. The primary domains are Technological knowledge (TK), Content Knowledge (CK), and Pedagogical

Knowledge (PK). TK refers to educators' knowledge about how they can use technology, tools and resources productively and continually on a regular basis [13]. CK is defined as educators' knowledge about the contents to be taught and learnt, whereas PK is referred to as educators' profound knowledge about the processes related to teaching and learning [13]. As highlighted in the TPACK framework, knowledge types that overlap between three primary domains are Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPACK). TCK describes the knowledge of how technology can create changes or new representations for the subject matter or vice versa [11, 13]. It was also explained in [13] that PCK indicates educators' knowledge in terms of how pedagogical approaches can be adapted appropriately in teaching. Besides, TPK denotes how teaching and learning may change when various technologies are used in teaching based on pedagogical designs and strategies [11, 13]. TPACK is the central intersection of the three primary domains in the framework. Hence, it is the combination of TK, CK, and PK that addresses educators' integrated knowledge of technology, content, and pedagogy into their teaching in any content area [11, 13].

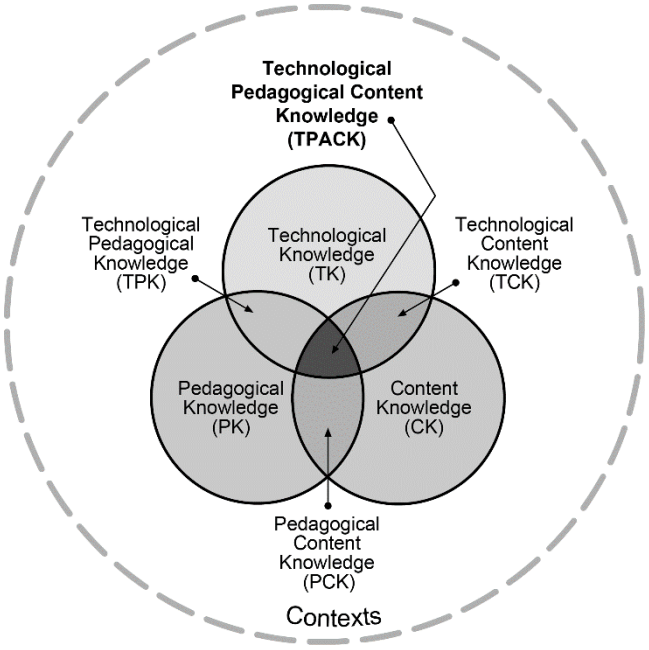

Fig. 1. Technological, Pedagogical Content Knowledge (TPACK) [14].

Due to the uniqueness of the TPACK framework, it has been widely used in various educational contexts, especially in training for educators from secondary to tertiary levels [3, 5, 15]. In a previous study, selected domains of TPACK were used to provide technology training for university lecturers to help them better relate the technology knowledge to actual contexts and practice how they can use the technology skills in

their respective content areas [16]. This study focuses on the technology domains of the TPACK framework to evaluate lecturers' skills in using technology namely videos and PowerPoint, in designing and presenting their lessons. Therefore, TK in this study refers to lecturers' knowledge in preparing and editing video lesson, while TCK indicates lecturers' knowledge in preparing and editing video lesson which fits the lecture content. TPK is referred to as the lecturers' knowledge in preparing and editing video lesson that matches their respective effective pedagogy, whereas TPACK denotes lecturers' knowledge in preparing and editing video lesson which fits the lecture content and matches with effective pedagogy.

3 Methods

This study involved 21 participants from a higher education institution in Malaysia, of which 19 were males and two were females. Among the participants, 18 were identified from a training needs analysis conducted earlier, whereby these lecturers indicated the need to cultivate the use of technology for effective teaching. The remaining three lecturers had volunteered themselves to attend the training. The training involved two experienced facilitators from the research team who also evaluated the lecturers' performance using the TPACK framework at the end of the training.

On the first day of the training, the participants were briefed on the digital natives and how the digital natives learn. They were also taught about approaches to teach the digital natives and the challenges they may face. Subsequently, the participants were trained in creating and editing videos such as trimming the video, inserting and formatting the photos and captions inside the video, animating the objects inside the video, applying effects on the video and exporting the video into different file formats and qualities using Easy Movie Maker freeware available from Microsoft Apps store. In addition, the participants were also trained on creating narrated PowerPoint lecture slides, embedding and trimming embedded videos, and screen recording to create video lectures using features available on Microsoft PowerPoint.

At the end of the first day, the participants were assigned to prepare a teaching plan based on the technology domains of the TPACK framework. They were given the freedom to decide on how they wanted to create the educational videos such as to adapt existing videos with some editing and formatting, to self-author or self-record video based on the video creating and editing skills learnt in training, or to do screen recording using PowerPoint slides. The two training facilitators evaluated the teaching plans and mock teachings making use of the educational videos created. They also provided feedback right after each presentation. The facilitators' evaluations were done using the TPACK framework on the second day of the workshop.

4 Results and Findings

Results presented in Table 1 to Table 5 are based on the evaluation of the teaching plans and the videos presented by the lecturers on a five-point-Likert scale evaluation ranging from strongly disagree (1) to strongly agree (5). Results are supported by facilitators'

feedback based on their observations of the lecturers' performance during the mock teaching.

Table 1. Descriptive statistics of the measured TPACK dimensions.

TPACK domain	Min	Max	M	SD
Technological Knowledge (TK)	1.83	4.33	3.468	.499
Technological Content Knowledge (TCK)	2.88	4.38	3.643	.426
Technological Pedagogical Knowledge (TPK)	2.50	4.38	3.482	.493
Technological Pedagogical Content Knowledge (TPACK)	2.00	4.50	3.286	.604

Table 1 shows the four technological dimensions of the TPACK framework that were evaluated by the two facilitators based on the presented videos. Based on the results, it was noticed that the training facilitators scored highest for the lecturers' technological content knowledge (M=3.643, SD=0.426). This is followed by their TPK (M=3.482, SD=0.493), TK (M=3.468. SD=0.499), and TPACK (M=3.286, SD=0.604).

Overall, the lecturers were competent at identifying the topics or contents appropriate to be presented using video and have the ideas on the best way to utilize the videos in their lessons. However, they were less competent to materialize their ideas and plans as they did not have sufficient knowledge and skills to identify and use the suitable technology such as utilizing video to craft an effective teaching and learning session.

In order to precisely determine the areas of knowledge and skills in creating an educational video that the lecturers had mastered, each of the technological dimensions of the TPACK framework was analyzed in detail.

Table 2. Descriptive statistics of technological knowledge (TK).

Item	Description	M	SD
TK1	The lecturer has good video making skills.	3.619	.610
TK2	The lecturer has good video editing skills.	3.333	.577
TK3	The lecturer is able to add in additional elements (e.g., annotations, narrative texts, quiz, simulation) into the video instead of narrating the content of PPT slides.	3.452	.498

Table 2 shows the results of lecturers' TK as evaluated by the facilitators. The training facilitators somewhat agreed that, on average, the lecturers demonstrated good video making skills (M=3.619, SD=0.610). The lecturers acquired fairly good skills in adding elements and features such as captions, transition effects and background music instead of just adopted the video or just narrated the slides (M=3.452, SD=0.498). Meanwhile, the lecturers' video editing and creating skills need to be sharpened further (M=3.333, SD=0.577), whereby some of the videos did not start or end timely or the effects applied were not ideal.

Table 3. Descriptive statistics of technological content knowledge (TCK).

Item	Description	M	SD
TCK1	The subject content is suitable to be presented by way of video lesson.	4.024	.295
TCK2	The video lesson has effectively presented the subject content in a clear manner.	3.548	.568
TCK3	The selected topic is appropriate to be presented within the allotted time.	3.833	.555
TCK4	The additional elements used (e.g., narrative texts, quiz, simulation) enhance the presentation of the subject matter.	3.167	.599

In terms of the lecturers' TCK, it is shown in Table 3 that the facilitators agreed (M=4.024, SD=0.295) that the lecturers were good at selecting topics that were suitable to be presented through video and within the allocated time limit (M=3.833, SD=0.555). Besides, it was agreed that the video lessons created could present the selected topics effectively (M=3.548, SD=0.568) to a certain extent. However, the lecturers needed to pay attention to the additional elements or effects used in their videos (M=3.167, SD=0.599). For instance, some lecturers had added strong background music that interfered with the presentation of the topic in the videos, while many of the videos did not add captions or indicators to highlight the area of focus while narrating the content, which usually causes difficulty for students to follow.

Table 4. Descriptive statistics of technological pedagogical knowledge (TPK).

Item	Description	M	SD
TPK1	The way of presenting the subject content through the video lesson enhances student's learning.	3.476	.642
TPK2	The subject content is presented in an organized manner.	3.929	.576
TPK3	Appropriate elements (e.g., graphical representation, narrative texts, simulation) have been employed to enhance the teaching of the subject content.	3.214	.561
TPK4	The presentation of the subject content is able to engage the audience.	3.310	.512

Based on the facilitators' evaluations shown in Table 4, facilitators scored the lecturers highest in TPK2 for TPK. The result suggests that the facilitators agreed (M=3.929, SD=0.576) that the lecturers were competent to present the subject content in an organized manner either through the screen-recorded video lesson or adapted videos. This is followed by TPK1 (M=3.476, SD=0.642) and TPK4 (M=3.310, SD=0.512), in which the facilitators fairly agreed that the lectures were able to present subject content using video lessons to enhance student learning and engage the audience respectively. Besides, the facilitators opined that there was room for improvement in terms of the use of appropriate elements (M=3.214, SD=0.561) such as background music, graphical representation and narrative texts that either makes teaching through video more engaging or annoying.

Table 5. Descriptive statistics of technological pedagogical content knowledge (TPACK).

Item	Description	M	SD
TPACK1	The video lesson shows that the chosen subject content has been presented effectively that will enhance the student's learning of the subject content.	3.286	.604

Table 5 illustrates the evaluation score for the lecturers' TPACK. Based on the results, the facilitators considered the lecturers were able to produce video lessons that enhanced students' learning to a certain degree (M=3.310, SD=0.512). There were areas, as highlighted above, that required more attention namely the technological knowledge and skills dimensions. This is because the limitation of knowledge and skills restrict the options of better educational technology and diminish lecturers' TPACK performance in teaching and learning.

5 Discussion and Conclusion

This study aimed to evaluate the knowledge and skills of trained lecturers in integrating video technology (videos and screen-recorded PowerPoint presentation) into teaching and learning using the TPACK framework. Based on the findings of this study, it can be concluded that the workshop reported in this study closed the training gap of 21 lecturers in a higher education institution in Malaysia.

Despite short training on video editing and screen recording, all the lecturers managed to produce their own educational videos and presented them on the second day of the training. There were adapted third-party videos with little editing embedded and played during the PowerPoint presentations, screen-recorded PowerPoint presentations, and a few fully self-created video lectures. The videos were mostly meant for in-class teaching, supplementary learning material of upcoming lectures, overview summary of the immediate past lecture, and one exception where the video was meant as a cue for class discussion.

Overall, throughout the hands-on training on editing videos using Easy Movie Maker software and screen recording using Microsoft PowerPoint, it was found that most of the lecturers were new to these skills, and they were generally weak in these areas. The common practice of the lecturers was searching for videos on desired topics and adopting the videos in teaching without editing or customization to better suit their context. The deficiency in the technological knowledge in customizing videos to teach among the lecturers had restricted or weakened their technological pedagogical content knowledge and skills. Therefore, the training conducted in this study was considered essential to enhance the lecturers' TPACK knowledge and skills to create and use educational videos in teaching.

This study has upskilled the lecturers' capability in using technology which is vital in higher education as it helps them to accommodate digital native students' needs and optimize learning across various fields of study [7, 10]. Though the global pandemic has popularized the TPACK concept and further increased awareness of educational technology, it should also be aware that technology integration in teaching is voluntary and continual, rather than an enforced alternative due to the pandemic [17]. Hence, educators' development of TPACK through training, as reported in this study, is

essential not only to improve the quality of teaching [13] but also to inform lecturers on how they can enhance pedagogical approaches to better deliver their lessons and engage their learners, who are the digital natives [18, 19].

Nonetheless, this study has a few limitations that should be addressed for future improvements. It was noticed during the two-day workshop that the lecturers had to prepare a video lecture overnight after learning the relevant technological skills on the first day of the workshop. Given the short period, the task was considered demanding, especially for the lecturers who were unfamiliar with producing and editing videos. This could have affected the lecturers' performance on the second day when they demonstrated their lesson and were evaluated by the facilitators. In future, workshop facilitators can assign lecturers from the same department or who teach the same subject to one group for lesson preparation and demonstration. This will encourage peer support while completing tasks and reduce lecturers' burden to practice new knowledge overnight. Besides, some of the lecturers proclaimed that it was difficult to incorporate all the four technological domains of TPACK framework together during the instructional process, especially when they needed to produce their own teaching aids using technology. It required more practice to hone their TPACK knowledge and skills.

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